A.D. 1867, 12*th* October. N° 2871.

SPECIFICATION

OF

JEAN BAPTISTE PIERRE ALFRED THIERRY.

SMOKE-CONSUMING APPARATUS.

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Smoke-consuming Apparatus.

LETTERS PATENT to Jean Baptiste Pierre Alfred Thierry, residing at No. 146, Faubourg St. Denis, Paris, in the Empire of France, for the Invention of "IMPROVEMENTS IN SMOKE-CONSUMING APPARATUS FOR STEAM BOILER AND OTHER FURNACES, AND IN MACHINERY FOR MANUFACTURING PARTS OF THE SAME."

Sealed the 31st January 1868, and dated the 12th October 1867.

COMPLETE SPECIFICATION filed by the said Jean Baptiste Pierre Alfred Thierry at the Office of the Commissioners of Patents, with his Petition and Declaration on the 12th October 1867, pursuant to the 9th Section of the Patent Law Amendment Act, 1852.

TO ALL TO WHOM THESE PRESENTS SHALL COME, BE IT KNOWN, that I, JEAN BAPTISTE PIERRE ALFRED THIERRY, residing at No. 146, Faubourg St. Denis, Paris, in the Empire of France, do hereby declare the nature of the said Invention for "IMPROVEMENTS IN SMOKE-CONSUMING APPARATUS, FOR STEAM BOILER AND OTHER FURNACES, AND IN MACHINERY FOR MANUFACTURING PARTS OF THE SAME," and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, that is to say:—

This Invention has for its object improvements on former Patents granted to me for smoke-consuming apparatus.

The principle of my Invention is still the same, the superheating steam to a suitable degree for promoting the combustion of smoke producing gases, the drawing in air by a jet, and the forcing in a current of steam for mixing it in the hearths or fire-boxes of marine and land furnaces with all the ignited gaseous products which are there disengaged during the combustion of all mineral or vegetable combustibles by the sole method of eddying and stirring up the gaseous products in the interior of the fire-boxes simply by projecting superheated steam into the fire-boxes of steam boiler furnaces into the hearths of furnaces and into the shafts of blast furnaces.

The improvements described in this Specification render my smoke-consuming apparatus entirely perfect, as they determine with precision the angles at which steam is to be blown into furnaces, with the view of drawing in the amount of air necessary for the complete combustion of the fuel, and for the production of colorless carbonic acid gas. These different angles are shown by the aid of a scale divided into degrees of the circle, and if they be suitably employed, as herein-after described, it is quite impossible not to obtain complete combustion of smoke, and also the highest possible yield of heat by following precisely the practical and theoretical instructions which I have herein-after given.

It has taken me ten years of work and daily experimenting to be able to describe and mathematically carry out the new and improved applications of my smoke consumer, which I am now able to certify accomplishes completely and economically the decomposition of all the gases which are generated in a furnace by the production of carbonic acid combined with its theoretical quantities of oxygen and nitrogen produced by the decomposition of the atmospheric air drawn in stirred up, and mixed in sufficient quantity therewith. It has been necessary for me also to improve and modify all the apparatus described in my former Patents to render them so simple and easy of application, adjustment, and working that anyone desiring to make use of them can apply them by the aid of the Drawings and descriptions which I append to this application. It is, then, the form, the modes of operating, and the construction of the new parts of my smoke consumers which I now wish to Patent, although these may be somewhat modified in exceptional cases, and more particularly the angles at which the steam is projected, which are almost invariable as to their inclinations more or less high or low into the interior of furnaces, may be increased or diminished on the same plane or planes, according to the degrees of the angles determined on for the purpose of introducing sufficient air for the complete combustion of the gases, and also for preventing the drawing down of these gases below the furnace bars into the ash-pit principally at the time of putting on fuel or the opening of the fire-doors

This being premised, I pass at once to the description of all the new applications which I have invented, and to the descriptions of the tools for boring with precision the projecting orifices in the nozzles, pipes, or tuyeres of the blowing apparatus placed in the interior or on the exterior of furnaces, and which tools serve to determine the angles at which the holes are bored through the metal in order that the steam shall always be guided by the orifices in the directions previously determined on by means of the degrees and angles marked on the sectors of my boring machines. In addition and with the view of modifying and of regulating the introduction of air into furnaces and to more easily remove slag and cinders therefrom I have designed a new system of jointed furnace bars which may be used when burning any kind of fuel; these furnace bars work so easily that they may be thoroughly cleaned in a few minutes of all residue which obstructs the spaces between the bars, and prevents air passing into the interior of the furnaces. In order to accelerate this introduction of air I have invented several blowers for drawing in air, which are described in this Specification, and by which the production of steam may be considerably increased, although the time required for raising steam is diminished. These blowers may be caused to act simultaneously or alternately with the smoke-consuming jets of steam, which draw in atmospheric air, and will produce instantly a rapid and brilliant combustion similar to that obtained in the best furnaces where nothing has been neglected for obtaining a complete and economical combustion of the fuel.

I also show a Drawing of an apparatus to be placed on the tops of chimnies or especially on the funnels of steam vessels; it may be furnished with a second screen placed above the first. This screen prevents a down draft of the gases in the chimney, facilitates their passing away, augments the intensity of the combustion, prevents smoke from passing down chimneys into apartments, and works equally well in all winds however violent.

In conclusion the new angles at which the steam is projected, as also the new forms of smoke-consuming apparatus, and the other apparatus relating to their manufacture and setting in place, are all adapted for introducing the requisite quantity of atmospheric air into furnaces in such a manner as to break up and mix all the ignited gases with the quantity of oxygen with which they are capable of uniting (according to their degrees of affinity more or less variable for the surrounding air) with a view to obtain, 1, carbonic acid; 2, oxygen; 3, nitrogen, and to obtain this latter in the best conditions for the complete combustion of combustible gaseous matters and of all vegetable or mineral combustibles.

BLAST FURNACES AND CUPOLAS.

My Invention is applicable to the melting of iron and copper, or to the fusion of other minerals and metals capable of being treated and melted in all kinds of blast furnaces or cupolas. The method which I employ is very simple. I effect the blowing by means of hollow rings of wrought or cast iron of great thickness, channels for air and water are cast or formed at the same time as the circle in order that air or water may be admitted into the hollow of the ring to prevent its melting or oxidizing too quickly by the action of the heat; in the same hollow ring orifices are formed across the interior or exterior diameter of the ring in order to be able to blow by the aid of nozzles of metal or other refractory material steam which has been superheated into the interior of the shaft of the furnace from that part of the circumference called the belly, and in the direction of the lining towards the two frustrums of inverted cones, and in the direction of the metal which sinks down constantly as it melts on to the upper part of the crucible or hearth. In one of the interior channels of the ring above mentioned air or water circulates constantly at its upper part, and in the second channel steam is superheated to be led by union joints on the exterior of the furnace or cupola into the interior of the tuyeres or nozzles for injecting superheated steam, and also when desired atmospheric air combined therewith. The air is drawn in directly by the vacuum produced by the current of steam; it is injected through orifices formed for the purpose into the interior of the blowing nozzles, which impel it together with the steam into the shaft above the boshes in directions more or less inclined either upwards or downwards. By these means the fire and fusion increase rapidly in intensity, the work is more quickly performed, the iron obtained is of a better quality, and I anticipate that steel might be obtained from the upper part of the crucible or hearth. The saving of fuel will be very considerable, and in addition the time employed for melting the minerals will be much shortened. Steam may also be blown in thin streams into the interior of the tuyeres employed in blast furnaces or cupolas by adapting in the pipe leading thereto at suitable distances from the nozzles hollow rings of iron connected with one or more small tubes, the circle being bored and tapped to receive nozzles bored out conically to different diameters, which nozzles are to blow in the direction of the currents of hot or cold air blown by the blowing machines into the hearths of blast furnaces or cupolas. It should be understood that the crowns or rings or the nozzles which are bent round horizontally may be of iron or other refractory metal, that they may be placed either vertically or horizontally in the blast pipe for hot or cold air, and that the injecing orifices blow constantly either along the central axis of the pipe or along its inner circumference, in order that the air forced forward by the blowing machine shall be drawn in as though by a piston forming a vacuum, and be further violently drawn in by the current of superheated steam, which accelerates its speed. The speed of the draft can be regulated at pleasure by opening more or less the inlet cocks through which the superheated steam passes.

The first part of this Invention relates to the blowing superheated steam into steam boiler and other furnaces, and so consuming the smoke produced therein.

In the Drawings hereunto annexed, Plate 1, Figures 1, 2, 3, and 4, show my improved smoke-consuming apparatus applied to a fixed steam boiler furnace. In these Figures A is the exit of steam for the blower; it should be at the highest point of the steam chamber, and always on the dome when the boiler is fitted with one; at its extremity there may be a syphon strainer. B, cock to admit the steam into the blower; C, escape cock, by which the state of dryness of the steam may be ascertained, and water drawn off. E, E, superheater, with a return into the steam reservoir of the boiler. F, steam blower; it is composed of a tube passing around the door and inside of the furnace, and its upper part is furnished with holes through which steam is projected in different directions on to the fire; this steam is superheated in two upright chambers, which are placed in the masonry in front of the furnace, and from which they receive a strong heat; they may also be protected from the flames by guards of metal, clay, or fire-brick. G, return pipe for the return of superheated steam to the generator. K, extractor for extracting the calcareous sediments held in suspension in the water of the boiler; this is done in order to prevent burning, and that the steam may be more easily produced the metal surfaces being always clean. O, box (formed in the casting, and furnished with a lid) for receiving the steam blowing apparatus. In the bottom of the box there are holes for the passage of the nozzles for projecting steam into the furnace; in the lid are corresponding holes, closed with screw plugs, which facilitate the cleaning of the nozzles when they are stopped up. P, inlet of steam to superheater. S, S, superheater and drier. With this apparatus wet steam may be taken from any part of the boiler; for example, from the cock P this vapour passes into the tube S, which is of an elongated U-form. It is placed in the flues and consequently is exposed to a very high temperature. Here the steam is dried and superheated, and returns by the tube G to the steam reservoir of the boiler; this steam may be employed by means of the tube H for the use of the smoke-consuming apparatus or for any other use, such as the heating of cylinders, &c., or for other purposes. This superheater can be so placed that it may be put up or taken away without any material alteration of the masonry of the furnace. S, S^1, steam pipe, and blower in the chimney; it is composed of an arched tube (formed in a crown or helix) placed at the base of the chimney, and pierced with holes, by which steam which is led from the boiler through a tap projected into the chimney; by this means a great draft is obtained when from atmospheric causes or from faults of construction air is wanting for the combustion of the fuel.

Figure 4 represents a front view and horizontal section of the front plate of a furnace specially adapted for readily applying and for inspecting and repairing the smoke-consuming apparatus, as also for the cleaning of the orifices, and for the passage of air around the nozzles. V, circular and horizontal blower furnished with nozzles; these nozzles are conical in the interior.

In Figure 1, Plate 2, of the Drawings is shown my improved smoke-consuming apparatus applied to locomotive boilers. In this Figure is shown the general application of the smoke-consuming apparatus to a locomotive boiler of the drying and superheating apparatus for the steam in the smoke box, and also of the blower in the chimney. A is the point at which steam for the smoke-consumer is taken from the dome of the boiler. B, cock for admitting steam into the blowing tube F. C, C, tube for conducting the steam from the cock B to the blowing tube F. F, blowing tube pierced with holes by which the steam escapes into the furnace at the angles indicated by the Drawing. G, moveable grate which allows of cleaning and even of instantaneously removing the fire and clinkers and cinder from the furnace. L, L, L, L, L, L, levers and connecting rods to work the grate. V, V, screw with its handle placed conveniently for the stoker to give the necessary movement to the levers L, L, L, L, L, for removing the grate. P, superheater of a serpentine form placed in the smoke box, and absorbing the heat from the flames passing from the furnace; the steam is admitted into this tube by a cock placed at any point on the boiler, and after having passed through the superheater re-enters into the boiler by the cock Q. Q, return of superheated steam into the dome of the boiler. R, exit of steam for the blower in the chimney. S, blower pierced with holes projecting the steam into the chimney for accelerating the draft and the combustion in the furnace, especially when stopping or just before the stopping of the locomotive, or when a quantity of fuel is put on.

On Plate 3 of the Drawings are shown details of various parts of the apparatus. Figure 2 is a perspective view of an apparatus having steam entrances at its two extremities and blow-off cocks in the middle. Figure 3, section of blower tube F, showing the inclination of the steam jets to the horizontal. Figure 4, section (taken through the axis of the furnace) of the apparatus (Figure 2) showing the inclination of the jets to the vertical. Figure 5, plan of the same apparatus showing the horizontal directions of the jets. Figure 6, perspective view of an apparatus passing along the whole length of the furnace, and having a steam entrance at one end and an escape cock at the other. Figure 7, section of blower tube showing the inclination of the jets to the horizontal. Figure 8, section of the apparatus Figure 6, showing the inclination of the jets to the vertical. Figure 9, plan of the same apparatus showing the horizontal directions of the jets. Figure 10, transverse section of the furnace showing where the jets strike the tube plate. Figures 11 and 12, modification of the preceding apparatus, consisting in replacing the tube F by an oval box of malleable cast iron with a blow-off cock, and in which are pierced holes. Figure 11 is the vertical section of the apparatus, and Figure 12 its horizontal plan. In the above Figures on Plate 3, A is the exit of steam from the boiler; B, steam pipe leading to the blower pipe; C, escape cock of the apparatus; E, hollow washers placed under the nuts which fix the apparatus to the boiler, and prevent deterioration and oxidation; F, steam blower pierced with holes of projection.

(Note.—The ciphers 1, 1^1, 2, 2^1, 3, 3^1, 4, 4^1, 5, 5^1, 5^{11}, in Figures 3, 4, 5, 6, 7, 8, 9, 10, 11, and 12 show where the jets strike on the tube plate according to their angles and the degrees of the circle; one or more of these holes may be stopped if necessary).

Plate 4 shows the smoke-consuming apparatus of a T-form. Figure 1, front view of smoke-consuming apparatus fixed in the front of the furnace; Figure 1^{bis}, longitudinal section of furnace with the apparatus applied. Figure 2, interior plan of furnace, showing the tube of the blower and the direction of the projection of steam. Figure 3, transverse section of cock and pipe for the admission of steam into the apparatus. A, pipe for admission of steam fixed to one of the cocks of the superheater, and led from the top of the dome of the boiler, where it is pierced, as is shown in Figure 6 by a certain number of holes by which the steam enters; B, three-way cock receiving the steam from the pipe A, and conducting it either to the escape D or to the pipe C of the superheating, blowing, and smoke-consuming apparatus. Figure 4, horizontal section of the whole apparatus. A, exit of steam; B, cock for admission of steam (see the details above); C, pipe leading to the apparatus; D, escape cock serving to empty water out of the pipe A before admitting the steam into the pipe C (see D, Figure 3); E, E, brass unions for connecting the pipes A and D on the cock B (see Figures 5 and 6); F, brass union for fixing the cock B to the tube C by which steam is admitted; G, support of the cock B fixed against the boiler by two bolts and nuts; H, flame guards placed below the blowing tube S to protect it from the direct action of the fire; it is formed of two pieces fixed by bolts under the frame of the door of the furnace (see Figure 10). S, tube of blower pierced with holes of projection. Figure 5, front view of three-way cock. Figure 6, extremity of the syphon for taking steam from the dome of the boiler. Figure 7, longitudinal and transverse section of the cock B. Figure 8, view of the plug of the cock with its screws and washers. Figure 8^{bis}, socket of the cock seen in front view with blow-off orifice and branch union. Figure 9, front view of the blowing tube taken inside the furnace; the lines 1, 2, 3, and 4 show the direction of the projection of steam. Figure 10, plan and section of the flame guard H. Figures 11 and 11^{bis}, collar placed under the frame of the furnace to support the tube B by which steam is admitted. Figure 12, catch for regulating the admission of air by the door of the furnace. Figure 13, handle of the cock B. Figures 14, 15, and 16, elevation of the tube plate in the interior of the boiler of a goods, locomotive, or one for steep gradients. The numbers 1, 2, 3, 4, 5, 6, 7, 8, 9, 1^1 2^1, 3^1, 4^1, 5^1, 6^1, 7^1, 8^1, 9^1, 9^{11}, indicate with the greatest precision by the centre of small crosses the exact points at which the jets strike, the inclination of projection being given by the longitudinal section (Figure 15) and the horizontal plan (Figure 16). The Figures on the sides of the furnace in elevation show the height at which the holes of projection are placed; this method of blowing may be varied according to the form and dimensions of the locomotives by stopping the holes 2, 2^1, 3, 3^1, 4, 4^1, 7, 7^1, and 9^1 if necessary, but this modification requires great practice in the fixing and working of the smoke consumer, especially on account of the speed of the machine and the draft of air between the fire-bars.

(Note.—The same holds good for all the other projections in the general descriptions of the application of my smoke-consuming apparatus).

Plate 5 shews the application of my smoke-consuming apparatus to the boilers known as Belleville's boilers. Figure 1, front view of the boiler, the apparatus being fixed. Figure 2, section through the centre of the boiler showing the vertical directions of the jets. Figure 3, plan of the apparatus showing the horizontal direction of the same. The ciphers 1, 2, 3, 4, 5, and 1^1, 2^1, 3^1, 4^1, 5^1, of the Figures 2 and 3 indicate the directions in which the jets of steam are projected into the furnaces.

(Note.—For the details of the apparatus consult the corresponding letters of the description relating to fixed steam boilers).

Plate 6, Figure 1, front view of a horizontal boiler having an interior furnace. Figure 2, longitudinal section of same with steam jets. Figure 3 shows a modification of the steam blowers and of the setting of the smoke consumers in steam boiler furnaces.

(Note.—For the explanation of Figures 1 and 2 of Plate 6, and 1, 2, 3, of Plate 7, refer to the corresponding letters of the description relating to fixed boilers except for the letter C which represents a metallic T-joint to join the steam blower D, D, to the pipe through which steam is taken from the boiler, and also for the letters D, D, which represent the superheating blower of the smoke consumer, and for the letters F, F, which mark the escape cocks of the smoke consumer).

Plate 7 shows the application of my smoke-consuming apparatus to a vertical boiler with interior furnace. Figure 1, section and elevation of the boiler, the blower being fixed; Figure 2, plan of the furnace of the boiler; Figure 3, front view of same. For the angles of projection 1, 2, 3, 4, 5, 6, 1^1, 2^1, 3^1, 4^1, 5^1, 6^1, consult Plate 5, Figures 2 and 3.

Plate 8 shows the application of my smoke consumer to a marine boiler. Figure 1, front view of the body of a boiler with four furnaces and section following the bent line 1, 2, 3, 4 (Figure 2), showing both the exterior and interior of the blowing apparatus; Figure 2, section of same following the bent line 1, 2, 3, 4, 5, 6, 7 (Figure 1), passing by the axis of the furnace and showing the angles of projection of steam into the interior of the furnace; Figure 3, modifications of the application of superheaters of smoke consumers and jets of steam projected into the furnaces of marine boilers.

GENERAL DESCRIPTION OF THE FIGURES 1 AND 2.

A, A, A^1, A^1, places in which the steam is taken from the body of the boiler for the smoke-consuming apparatus. The steam should be taken through a system of syphon pipes terminated by a rose pierced with long holes so as to dry and strain the steam as much as possible and these should be at the top of the boiler. When the boiler has a superheating tube the cock A^1, A^1, for taking the steam may be fixed in this tube. B, superheating tube receiving the steam from A and placed in the smoke box above the tube plates so as to receive all the heat which comes from them; on this tube are adjusted the pipes C for distributing the steam to each furnace. C, pipes distributing the steam to the boilers, and placed in each smoke box along the water spaces, coming out at one of the lower angles of the doors and of the tube plates. D, cock to admit the steam to the furnace. E, tubes conducting the steam along the doors of the furnaces passing into the ash-pits and communicating with the boxes of the blower across the dead plate of the furnace. F, box of the smoke-consuming blower. The cover of this box is pierced with holes through which the superheated steam is blown on to the furnace; suitable holes for cleaning are provided. G, escape cocks of the apparatus. H, dead plate of the furnace which supports the blowing apparatus; this plate is pierced by two rectangular holes for the passage of the admission pipe and the blow-off pipe. L, register door for regulating the introduction of air into the furnace. M, catch for regulating the opening of the door. N, handle of the escape cock placed conveniently for the stoker. P, exit from boiler of steam for the blower in the chimney. Q, hollow iron ring conducting the steam into the blowers. R and S, R, nozzles pierced with holes converging to the centre of the chimney to produce a draft there; S, S, roses placed near the centre and pierced with conical or cylindrical holes through which steam is projected towards the sides of the chimney (they unite in a cone).

DETAILS OF THE APPARATUS ARE SHOWN IN PLATE 9.

Figure 1, longitudinal section of the blower pipe A; Figure 2, exterior view of same. A, rose pierced with long rectangular holes for the introduction of the steam into the tube B. B, syphon tube conducting the steam to the cock C. C, cock serving to admit or cut off steam from the apparatus. D, tube conducting the steam from the cock C to the smoke box; this bent tube traverses the top plate of the boiler into which it is screwed, and descends to the smoke box where it joins the cock E. E, union for the pipe connecting the inlet pipe A with the superheater B.

Figure 3, front view of the superheater B. Figure 4, exterior view of same. Figure 5, details of the connections of the superheater B with the pipes C for distributing steam into each furnace. A, A, superheating tube resting on the water spaces; B, union of the superheater with the steam pipe E (see Figures 1 and 2); C, washer on the tube; D, union of the superheater with the pipes for distributing the steam; E, elbow bend; F, distributing pipes descending along the water spaces serving as supports to the tube plates and coming out of the smoke box by means of the elbows G; G, right-angle bends on which are fixed the tubes coming out of the smoke box; H, union connecting the pipes F and I; I, bent tube coming out of the smoke box; J, union plate connecting the tube I to the cock D; K, collar for fixing the superheater to the water spaces (see Figure 3).

Plate 10, Figure 1, view of the side of the blower which is towards the fire. A, junctions of the box with the supports (Figure 8) serving to admit steam and for blowing off. B, screw hole to receive the screw which supports the box across the top of the furnace. C, holes of projection. D, nuts and screws serving to fix the cover (Figure 2) on the box of the blower. E, holes for cleaning the nozzle; these holes are closed by means of plugs.

Figure 2, side view of cover of the box of the blower; C, holes of projection; D, holes through which the screws pass which fix the cover on the box.

Figure 3, E, E, screw plug having a pin to stop or open the nozzles and to regulate the escape of steam. Figure 4, screw sockets for joining the hollow supports (Figure 8) to the blower box. Figure 5, dead plate. A, holes for the passage of the supports; B, bolt holes for fixing the guard boxes called flame guards.

Figure 6, screws for fixing the supports (Figure 8) to the dead plate (Figure 5); Figure 7, hollow washers placed under the screws (Figure 6); Figure 8, hollow screw bolts for supporting the blower box and also for admitting and blowing off steam; Figure 9, cock for admitting steam; Figure 10, blow-off cock; Figure 11, support fixed on the door of the furnace by means of the rivets C; Figure 12, hinge of catch; Figure 13, guard box placed in the furnace on the dead plate to protect the supports (Figure 8) from the flames; Figure 14, Nos. 1, 2, 3, 4, 5, 6, 7, screws and bolts for fixing together the above parts; Figure 15, supports of the dead plate of the furnace under the grate; Figure 16, blower in the chimney. A, point at which the steam is admitted into the blower; B, C, D, blower tube terminated by balls pierced with holes; F, tube connecting the blower tubes. Figure 17, junction pieces at the ends of the superheater; Figure 18, junction piece of the superheater fixed in the smoke box with screw joint in the boiler, the superheating tube A being supported by a washer; Figure 19, washers for joints of superheating pipes and of steam pipes with binding screws; Figure 20, screen for preventing the flow of exterior air into chimneys and so preventing them from smoking; Figure 21, 21bis, regulating blowers which may be applied to the chimneys of all steam boilers to regulate the draft and combustion of the furnace according to the richness of the fuel in hydrocarbons.

In Plate 11 of the Drawings is shown a drilling machine for drilling the holes of projection in tubes of any diameters.

GENERAL DESCRIPTION OF FIGURES 1, 2, 3, 4.

A, tool carrier; B, B, pressure screw with its hand wheel; D, guide of the shackle; E, E, bevilled toothed wheels increasing five-fold the speed given by the handle; F, F, frame of drilling machine; G, eye for fixing the sector O, P, to the frame; H, part of the eye adjusted so as to slide easily in the sector; J, adjustment on the top of the connecting rod supporting the screw K; K, K, right and left hand screws in the jaws of the vice; L, L, parallel hollow jaws of vice holding the tube to be pierced; O, P, sector concentric with the tube to be pierced. This sector is divided into degrees, the zero point being on the axis of the vice L; S, pointer in the horizontal axis of the tube for fixing the machine on the axis; U, rigid rod for fixing the sector O, P, to the vice L.

Description.

L, vice with hollow jaws for holding the tube to be pierced. This vice is furnished with a right and left hand screw through both of its jaws and adjusted on a rigid rod U by means of a head J; a bolt placed at the other extremity of the vice passes through the rod U and the two jaws, and is furnished with a brass washer; its use is to maintain the parallelism of the jaws in pressing them towards the support U after having permitted them to slide to the necessary extent on this support; this varies according to the diameter of the tube to be pierced. By this means the jaws can be approached or made to separate in a parallel direction by turning the screw *k* by means of a key without changing the direction of the axis of the vice with respect to that of the tube, and at the same time to obtain an equal and rigid pressure on the tube whatever be its diameter.

Figures 1 and 2. Iron rod carrying at one extremity the head J in which is adjusted the screw *k* and terminated at the other extremity by a sector O, P, of which the radius is always equal to the distance of its axis from the centre of the tube held in the vice, and whose circumference is always concentric to that of the tube. The sector is divided into degrees, the zero point being on the axis of the vice.

Figures 1 and 2. Moveable pointer in the longitudinal axis of the vice and indicating on the tube the axis of the system. By means of a line traced along the tube in the direction of its axis and by always holding the pointer in this line any number of holes may be pierced in the tube, according to the angle indicated in degrees in the Drawing, either above or below the line of axis corresponding to zero point.

Figures 2 and 4. A, steel tool holder adjusted on the pinion E and receiving from it a rotary movement about its axis; G, slide adjusted on the sector O, P, by its square part H sliding in the groove of the sector, and to which it can be fixed by means of a set screw; F, frame carrying the whole of the drilling machine. This frame is fixed to the sector O, P, by means of the slide G to which it is fastened by a nut and bolt; it can thus slide along the whole length of the sector in such a way that its vertical axis always points in the same direction as the radius of the sector, and always passes through the centre of the tube to be pierced. If necessary it can be turned the other way, its joint with the slide G being the hinge.

Figure 3. E, pinion fixed on the frame so as to turn freely about itself; it is furnished with a small key fixed in the interior of its axis sliding in a groove along the tool carrier A to make the latter take its rotary motion. E^1, cog wheel turning the pinion E; the axle of this wheel is adjusted in the frame F and is terminated by a square carrying the handle, which by its means gives the motion to the tool carrier and increasing five-fold the original speed. B, pressure screw acting directly on the tool carrier; it is furnished with a hand wheel which facilitates its manipulation. C, shackle which joins the end of the screw B to the head of the tool carrier A and serves to withdraw the latter. D, iron guide on which slides the shackle C.

DRILLING MACHINE

for boring the projection on the plates of the blowing boxes of the boilers.

GENERAL DESCRIPTION OF FIGURES 5, 6, 7.

A, tool carrier provided with pressure screw and crank handle; B, milled-headed nut for actuating the pressure screw; C, link uniting the tool carrier A to a sliding bolt D by a hinge joint; D, sliding bolt serving to advance, draw back, or place obliquely the tool carrier with respect to the upright F. This arrangement together with the jointing of the link C permits of setting the tool carrier at any angle with the column F; E, double slide connecting the cross slide D with the upright F; F, F, upright supporting the machine and capable of being fixed on the piece to be bored by means of a long slot formed through its foot, and through which is passed a binding screw.

DESCRIPTION OF FIGURES 8 AND 9.—DETAILS OF TOOL CARRIER.

A, tool carrier furnished with its pressure screw and handle; B, hollow screw to receive the tool carrier A, and having along its outside a groove which prevents its turning on the slide D; C, milled nut serving to raise or lower the screw B in the slide D and carrying the tool carrier A; D, slide in which passes freely the screw B, and which is furnished with a small fixed key running in the groove of this screw to prevent its turning. The screw C is adjusted between the cheeks of the slide. E, E, handle to turn the tool carrier A in the interior of the screw B; it is fixed to the tool carrier by means of a screw cut on the latter.

Modification of the preceding machine so as to enable it to pierce nozzles formed on tubes of any diameter.

DESCRIPTION OF FIGURES 10 AND 11.

(Note.—To letter E inclusive refer to the general description of Figures 5, 6, and 7).—F, vice with hollow jaws for holding the tube to be pierced whatever be its diameter. The column F (Figure 5) serving to support the whole drilling machine.

MACHINE FOR CUTTING SCREW THREADS ON TUBES OF LARGE DIAMETERS.

Figure 12. The advantage of this machine over former ones is that a single man can cut screw thread on a tube of large diameter which with ordinary tools would employ at least six men unless they used a screw cutting lathe. In this case the advantage of the apparatus is to replace the lathe with a portable apparatus.

DESCRIPTION.

A, block of hard wood, through which passes a female screw in metal of the same pitch as that to be cut. This block is adjusted in the interior of the tube on which is desired to cut the thread by means of keys working in grooves cut on the block for that purpose; B, B, screw passing through the block, and on which is fixed the frame carrying the tool; C, C, brass or steel guides with thumbscrews C to regulate the motion of the tool carrier according to the diameter of the tube to be operated upon; D, tool with screw B to regulate the cut; E, E^1, supports of the tool carrier and guides; they slide on a plate, to which are fixed by means of screws *e*, *e*^{1}, F, lever with handles serving to turn the whole machine about the tube. The tool is made to advance by the screw B which turns simultaneously in the block A. A, screw plate with jointed jaw; B, lower part of the frame; B, B^1, handles for turning the screw plate; C, jointed jaw for regulating the diameter and depth of cut of the screw to be formed; D, washer and bolt for fixing together the pieces B, B^1, B^1, and C; E, moveable jointed piece for holding by means of the screw F the dies; F, regulating screw; G, screw for adjusting the jaws C, H, so as to regulate with precision the diameter and depth of the screw to be cut; H, extremity of the jaw or vice tapped in the interior for receiving the thumbscrew G.

(Note.—This tool specially employed for cutting screws, bolts, &c., and cutting threads or tubes of the size and dimensions where precision is absolutely required).

Plate 12 shews a furnace for puddling and running iron.

DESCRIPTION OF FIGURES 1 AND 2.

A, A, A^1, syphon tube and cock for introducing steam into the superheater; B, regulating cock of the superheating tube, or of the chamber G with the second blowing and superheating chamber G; C, second tap for regulating the introduction of steam into the blower E; D, inlet of steam into the blower E in connection with the superheating chambers or tubes G, G^1; E, lower blower and sucker of the surrounding air below the grate; F, escape cock for the admission of steam pipes for the tubes and blowers E, G, G^1; G, hermetically jointed superheating chamber; G^1, similar chamber to G, with this difference, that the plate which covers the tubes or the nozzles injecting into the interior of the furnace is regulated with inlet orifices on the exterior, and orifices for projecting air and steam into the interior of blast or boiler furnaces in general, which by means of registers or lap screens are opened or closed at will according to the high temperatures of the furnaces of the superheating plates of the steam chambers and of the chambers for injecting air.

Plates and register valves graduated and moveable, serving for introducing free air below the superheater G of the blowing chamber G^1, in order to prevent oxidation and too rapid a deterioration of the several parts shewn at Figures 3 and 4; these registers can be closed almost completely by means of strips of iron sliding freely on guides or ribs on the frame plates of the furnaces. H^1, section of the openings formed in the plate or in the frame of the furnace; the same inlet and outlet openings or orifices for free or compressed air are placed opposite the registers or closing covers in such manner that they may, as desired, be opened or closed gradually.

Figure 3. General plan of a puddling furnace, shewing the jets of steam projected from the nozzles and cones of the blowing tube and in the plate, by which the furnace is surrounded. I, T-iron support of the lower blower, J surrounding frame of the furnace with details of the union joints.

(Note.—For the other letters see corresponding descriptions).

Figure 5. A, A^1, inlet of vapour into the blower K; B, tube for cleaner or for conducting steam into the lower blower D; K, K, smoke-consuming blowers seen in front view, the covering plate G being removed; L, L, tapped holes to receive plugs placed opposite the projecting nozzles.

Figure 6. (Note.—For the letters A, B, K, L, L, see description given above of Figure 5.) M, M, nozzles for projecting steam screwed into the face of the blower tube which is towards the fire. The nozzles are bored internally to a cone to facilitate the introduction of a wire, either for cleaning the orifices or for stopping them up should it be necessary.

In Figure 1, Plate 7, A is the steam inlet; B, cock by which it passes to the blower; C, bent union for coupling the syphon with the smoke-consuming apparatus; D, superheater smoke-consuming blower passing through a hollow stay; E, orifices for projecting superheated steam.

Figure 3. For the letters A, B, C, D, E, the description of Figure No. 1 must be consulted. F, emptying or cleaning cock.

Plate No. 3. A, inlet of steam; B, tap by which it passes into the smoke-consuming apparatus; F, superheating chamber of the smoke-consuming blower, with distributing nozzles at the angles desired.

In witness whereof, I, the said Jean Baptiste Pierre Alfred Thierry, have hereunto set my hand and seal, this Tenth day of October, in the year of our Lord One thousand eight hundred and sixty-seven.

J$^{N.}$ B$^{TE.}$ P$^{RE.}$ ALFRED THIERRY. (L.S.)

LONDON:
Printed by George Edward Eyre and William Spottiswoode,
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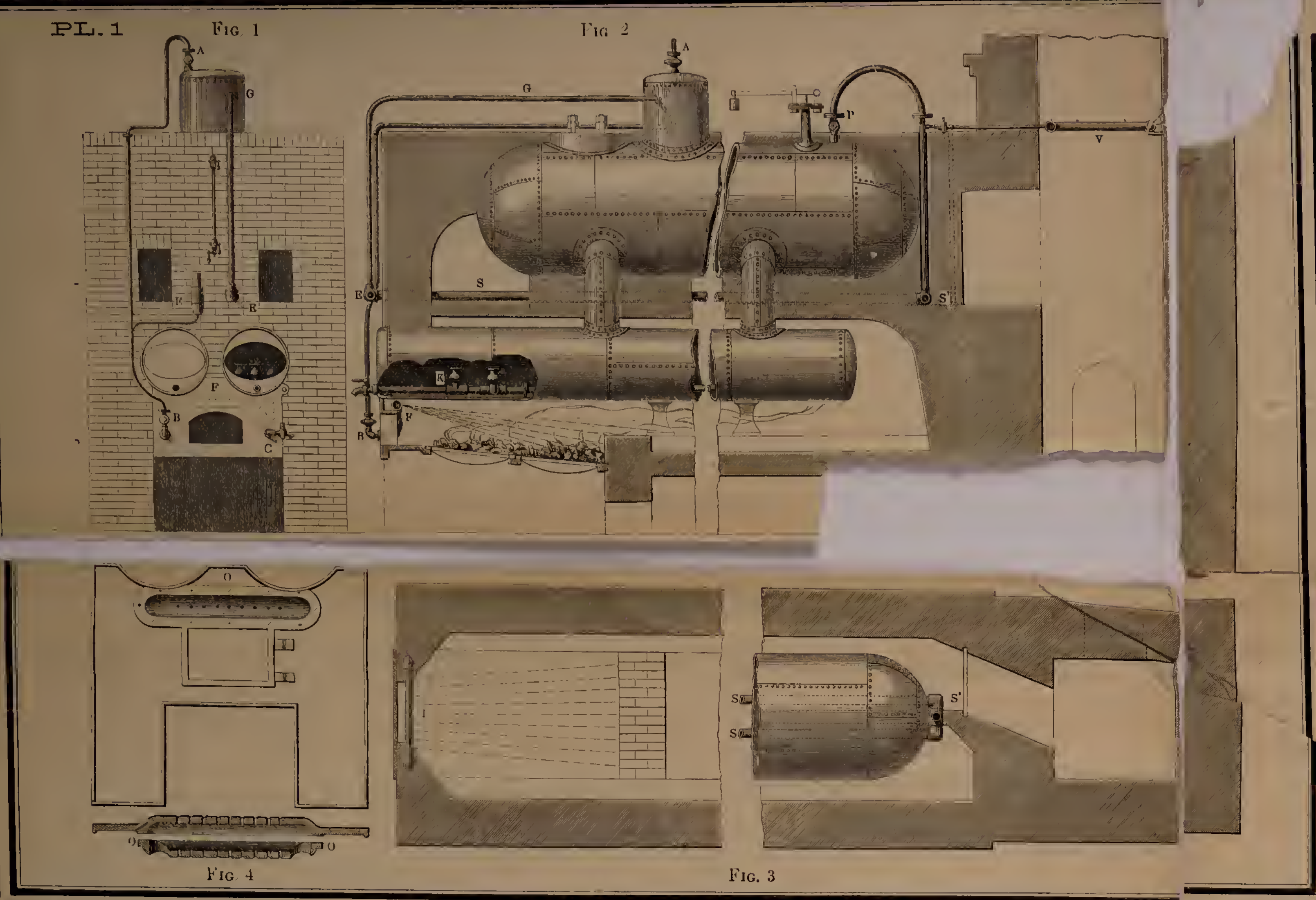
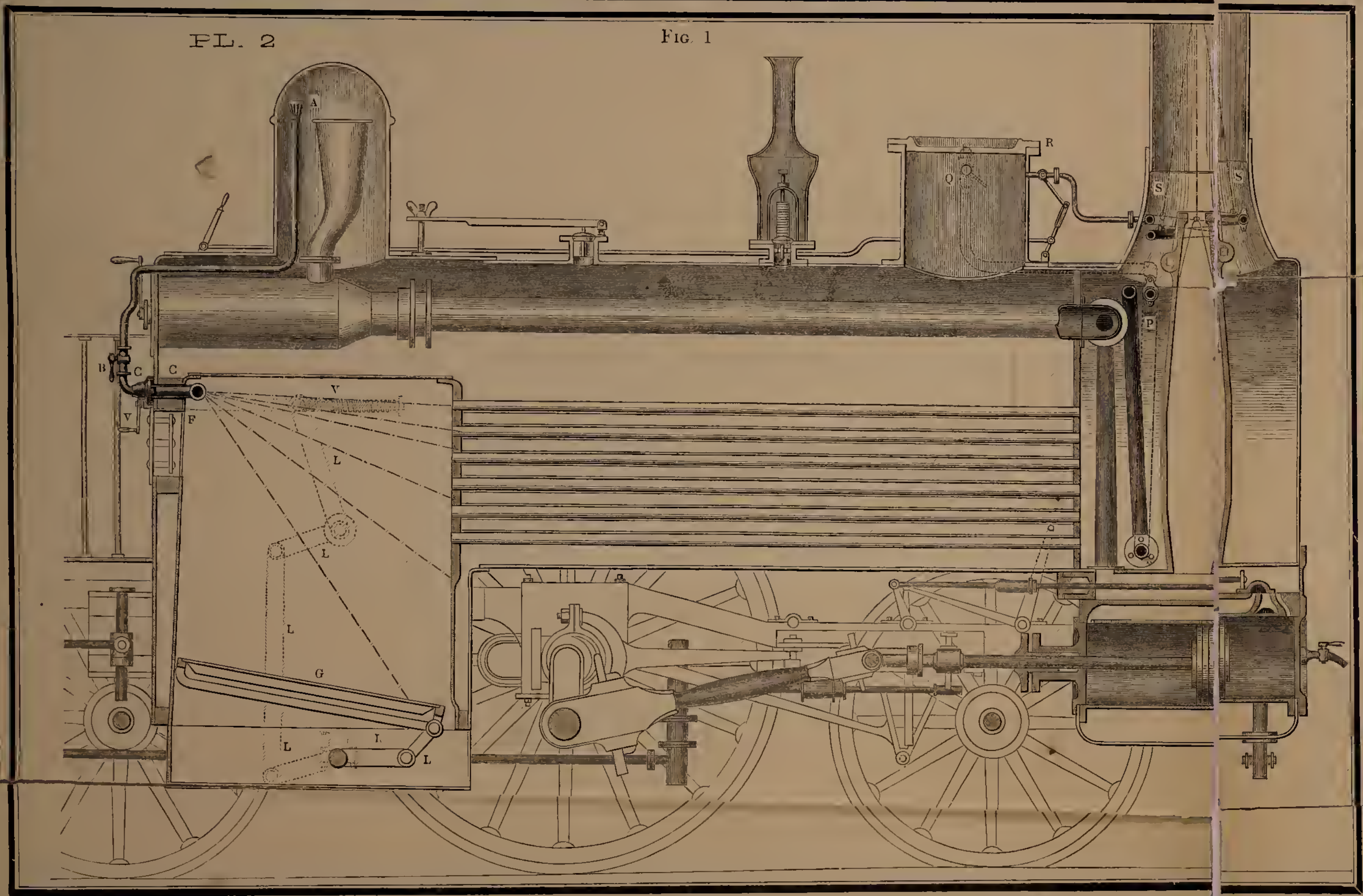
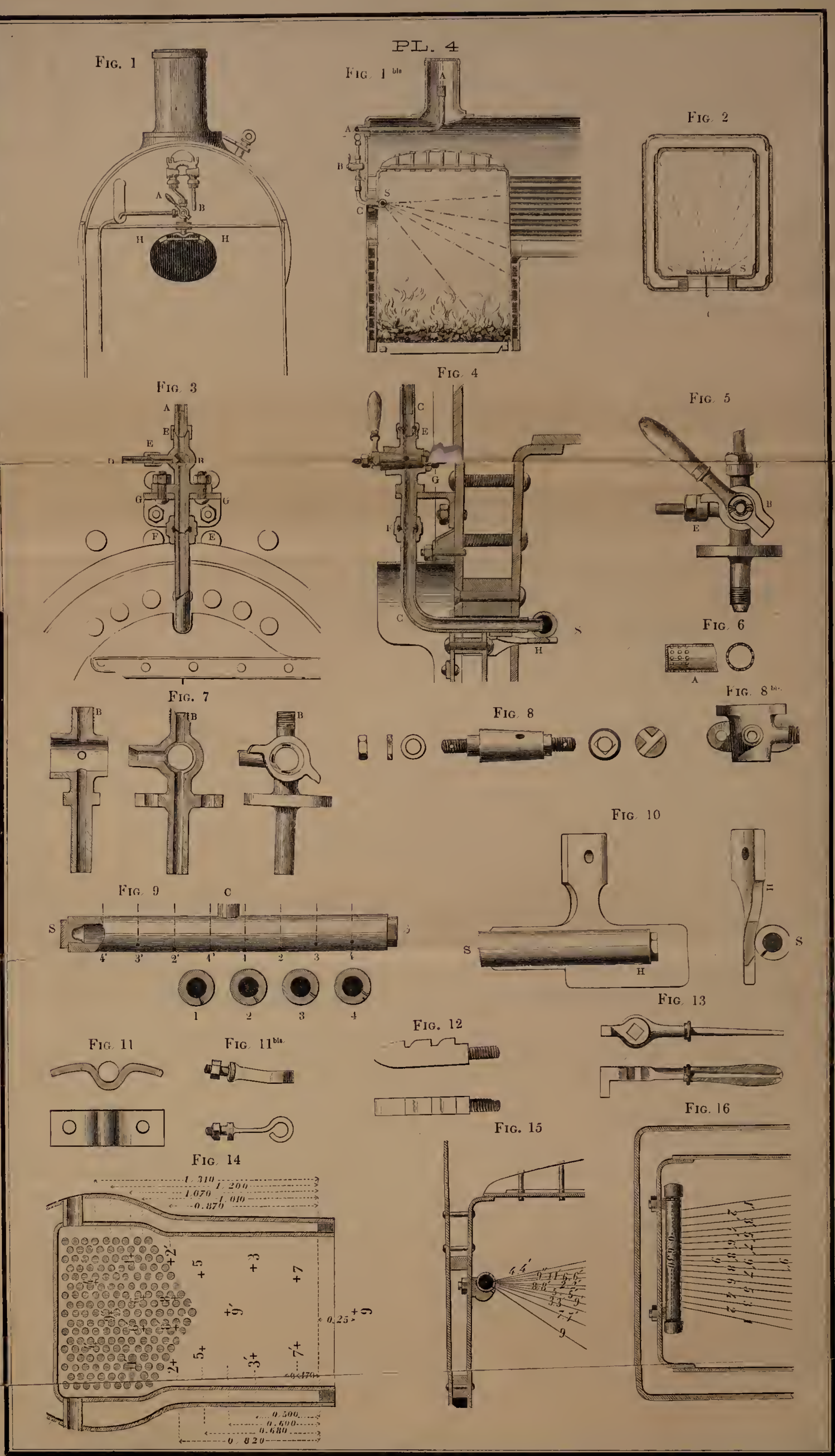
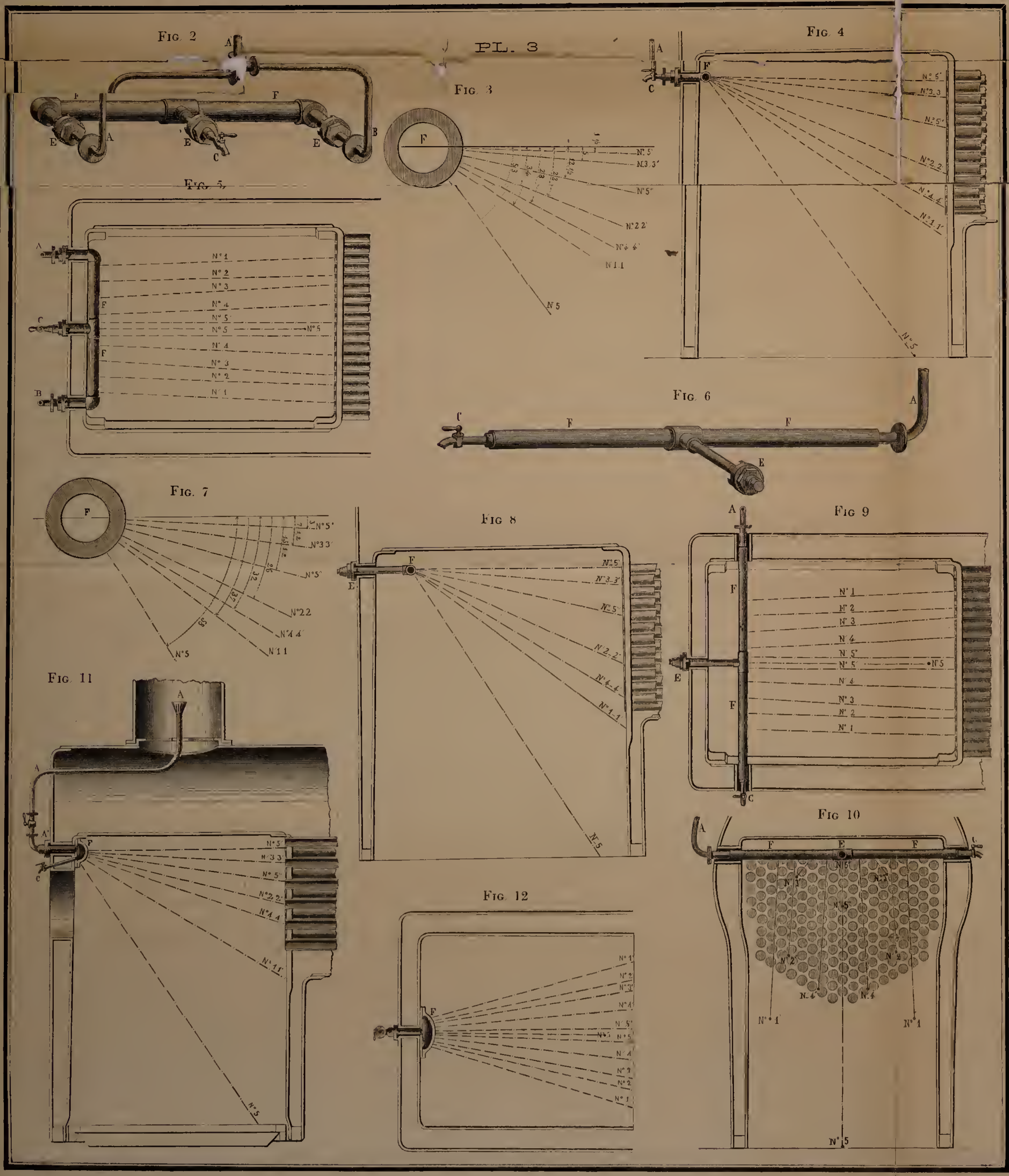
THIERRY'S SPECIFICATION.

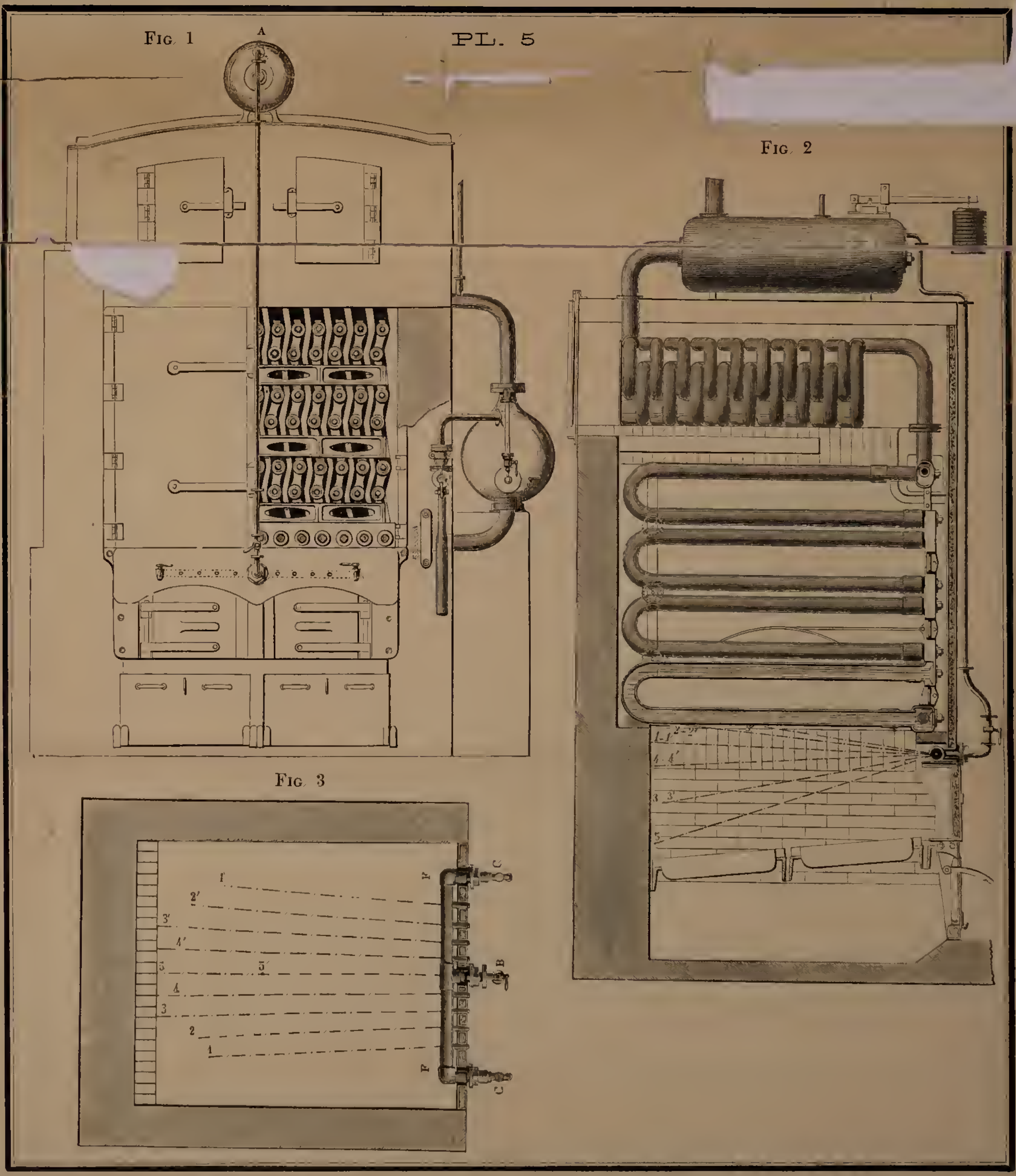
SHEET 1

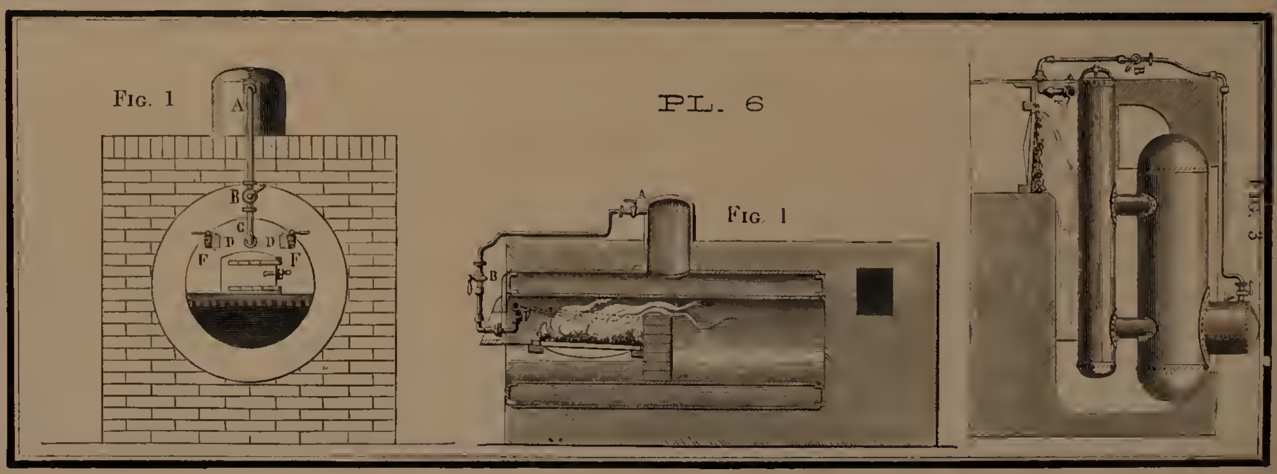












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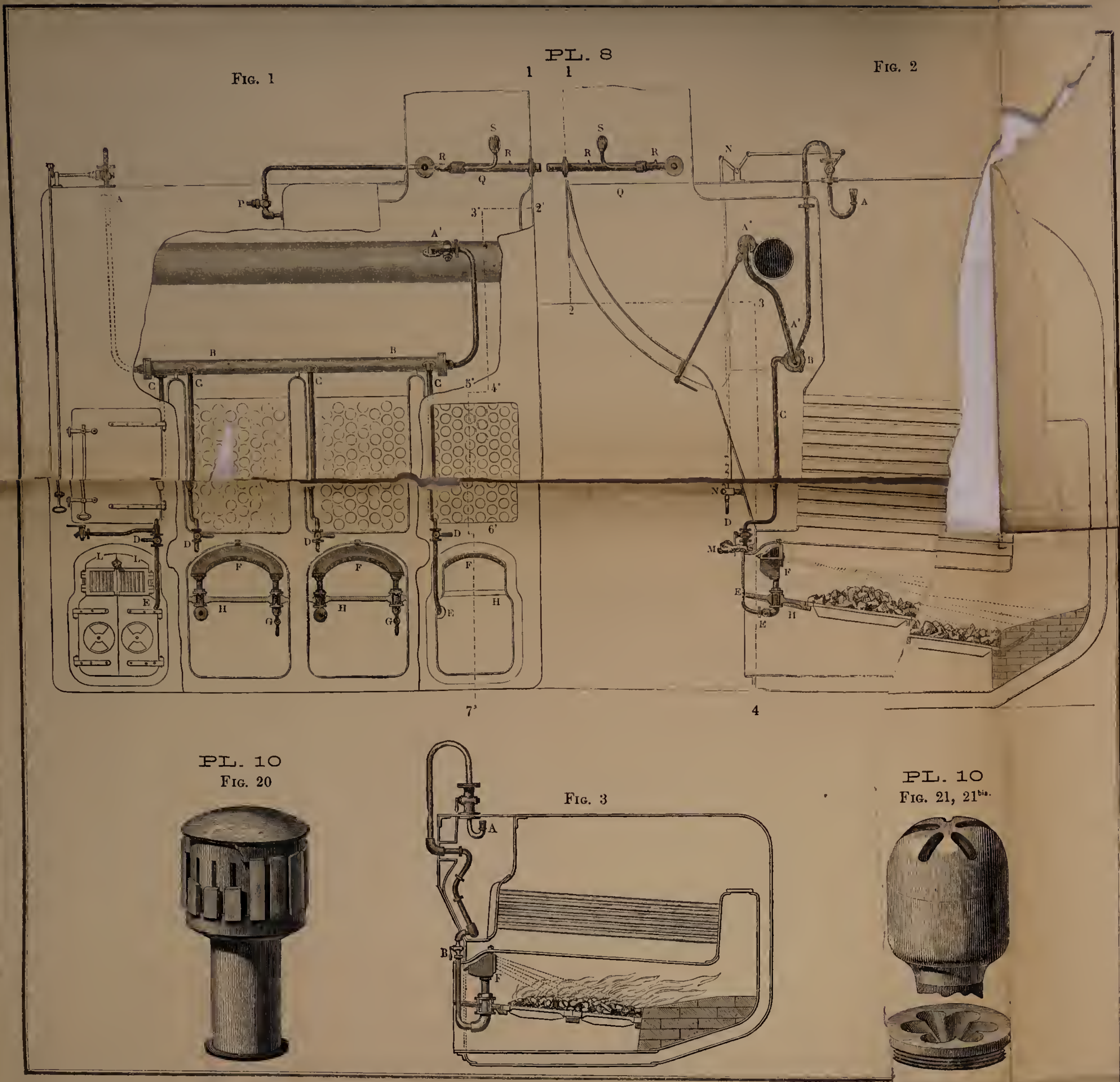

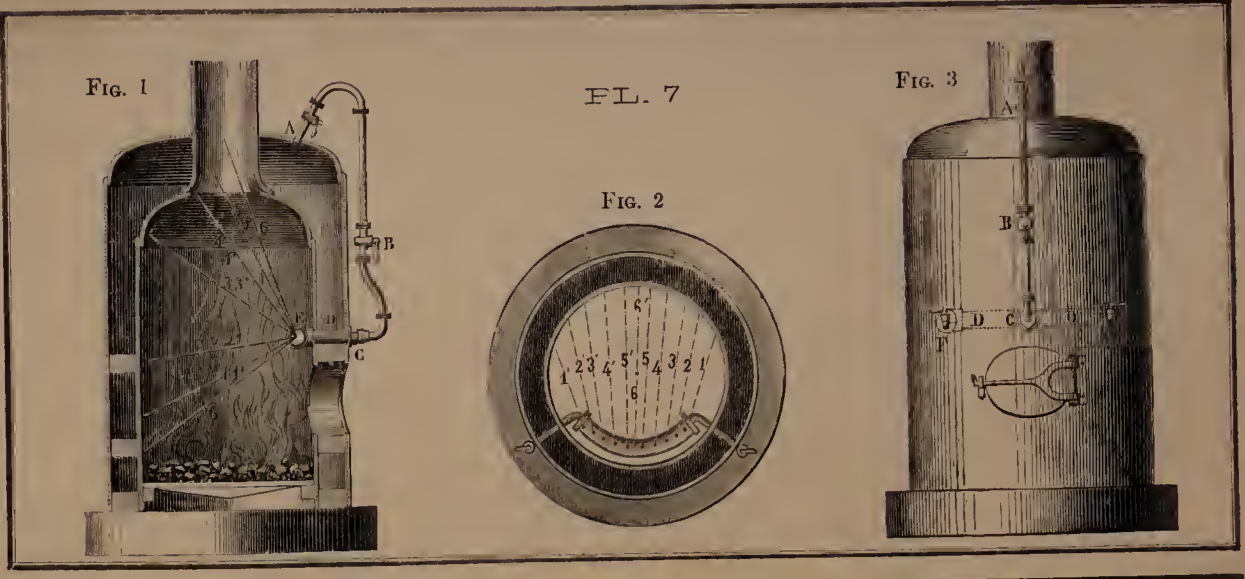

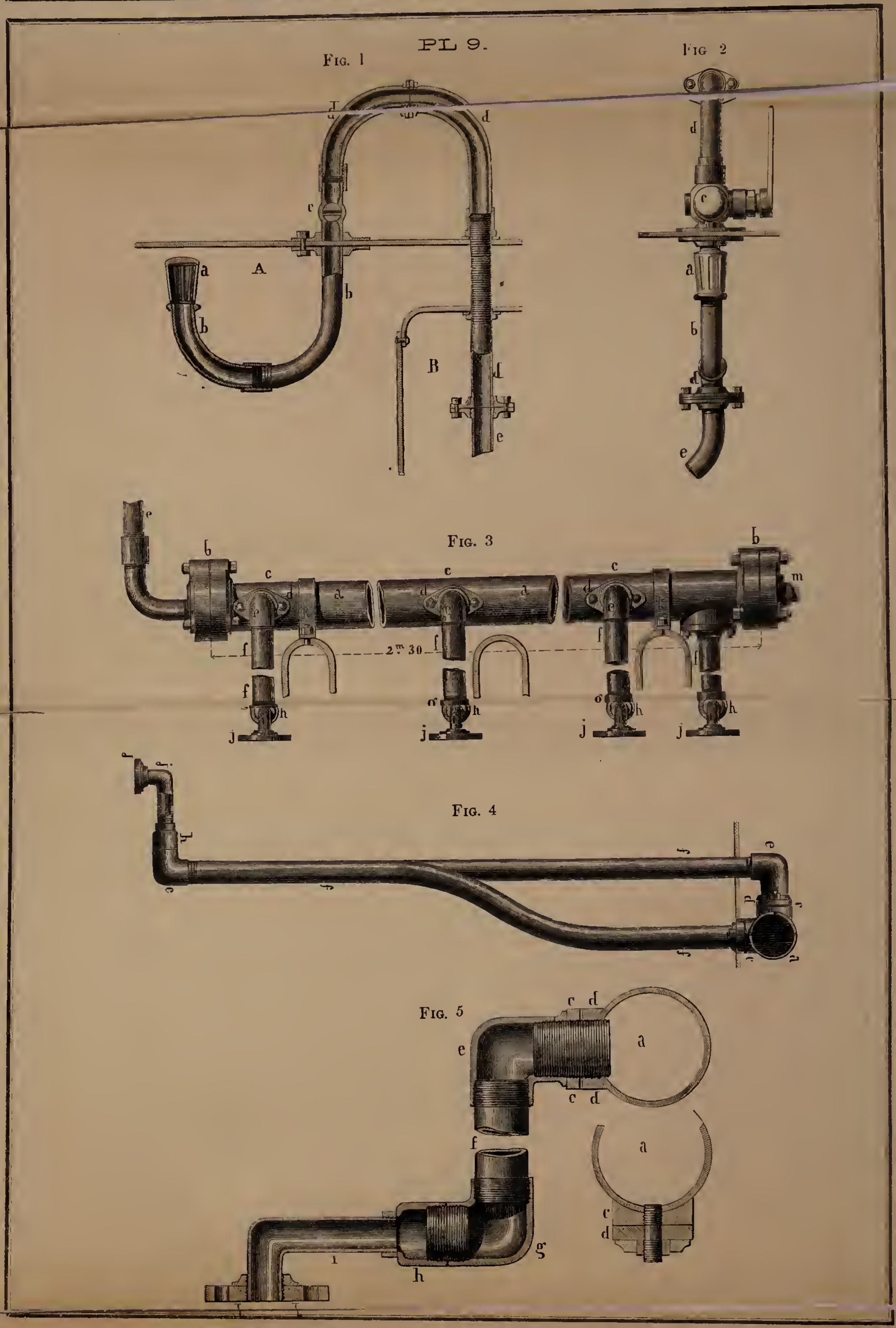

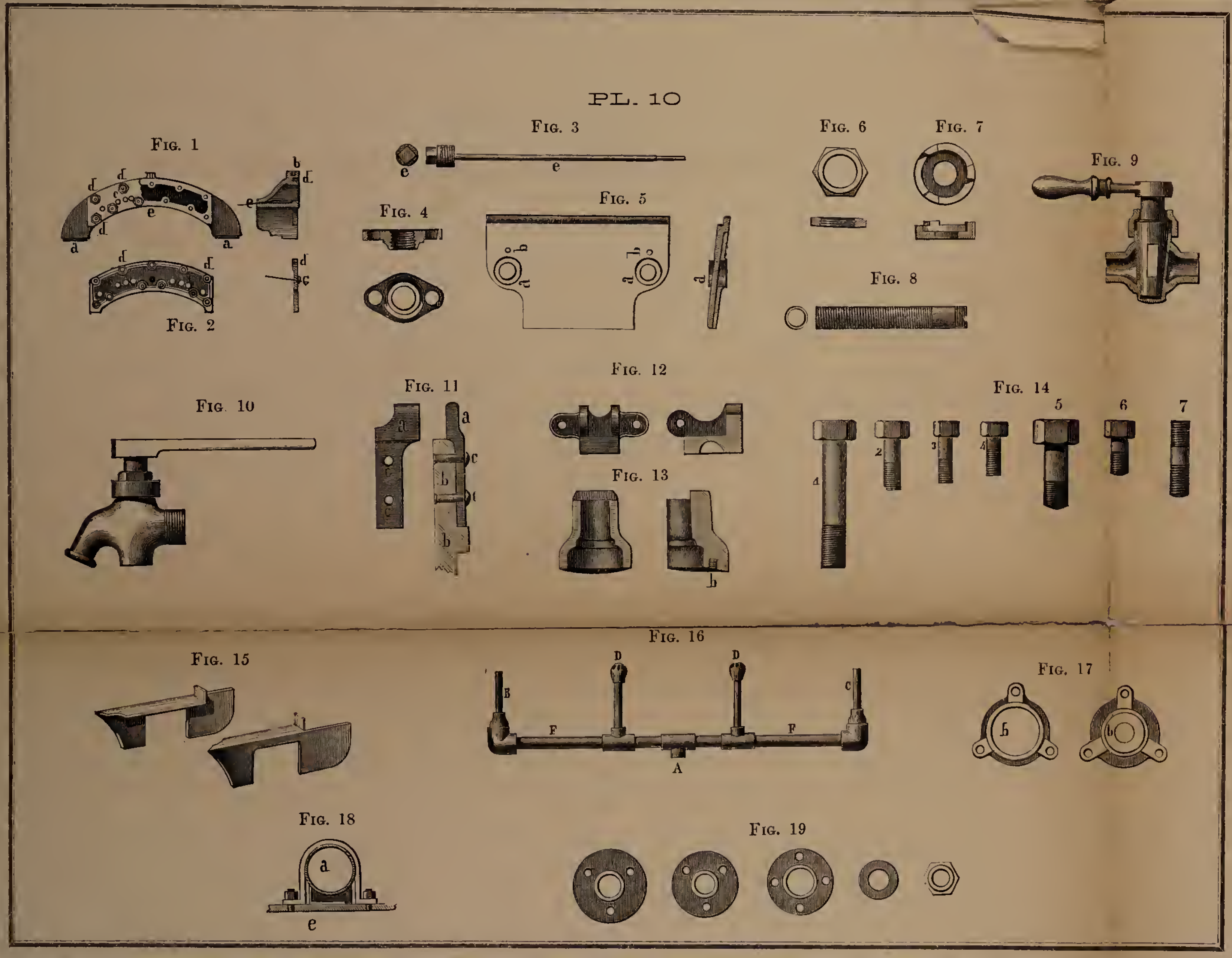

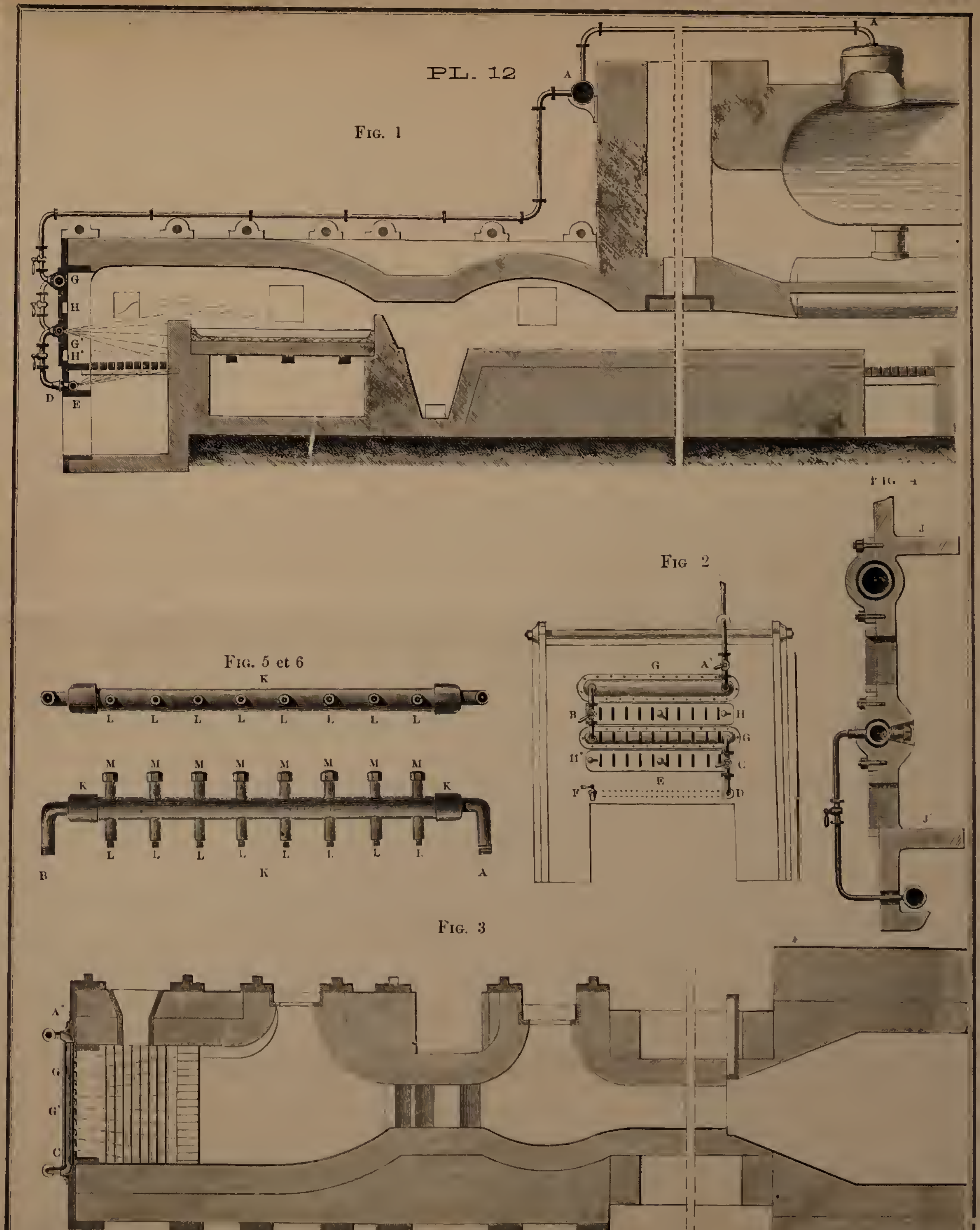

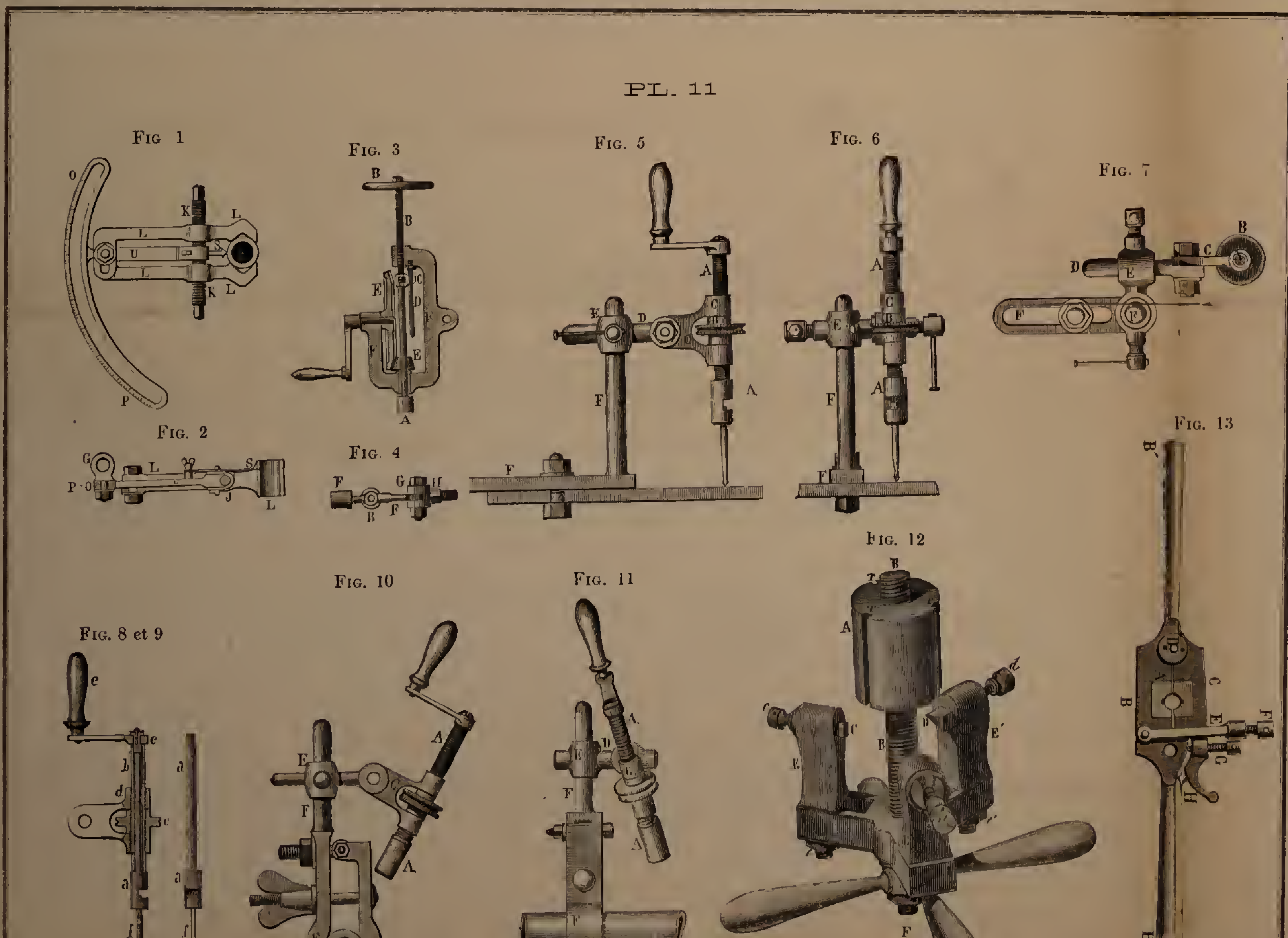

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